

Section 2

STREETS

2.0 GENERAL

The developer is required to have a qualified Project Engineer inspect the project during construction for the purpose of providing verification of materials and tests in conformance with Section 1.16, item 2, and to verify that the project was constructed in accordance with the approved plans.

2.1 EXCAVATION, BACKFILLING, AND COMPACTING:

A. GENERAL

DESCRIPTION

1. This work shall consist of excavating and grading roadways, (including the removal of slides), borrow pits, waterways, channels, intersections, approaches, steps in side-hill embankment areas, excavation of surfaces and pavements, excavating selected material found in the construction area for specific use in the construction; the construction and removal of detours shown on the plans or authorized by the Engineer, trimming and shaping of slopes, and disposing of all excavated material in accordance with these specifications and in reasonably close conformity with the lines, grades and typical cross sections shown on the plans or established by the Engineer. It shall include placing of material in embankments.

QUALITY ASSURANCE

1. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.
2. Use equipment adequate in size, capacity, and numbers to accomplish the work of this Section in a timely manner.
3. In addition to complying with requirements of governmental agencies having jurisdiction, comply with the directions of the Engineer.

B. PRODUCTS

SOIL MATERIALS

1. Fill and backfill materials:
 - a. Fill material is subject to the approval of the Engineer, and is that material removed from excavations or imported from off-site borrow areas, predominantly granular, non-expansive soils free from roots and other deleterious matter.

- b. Do not permit rocks having a dimension greater than 1" in the upper 12" of fill or embankment.

C. EXECUTION

SURFACE CONDITIONS

1. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

GENERAL CONSTRUCTION REQUIREMENTS

1. Prior to the beginning of excavation, grading and embankment operations in any area, all necessary clearing and grubbing in that area shall have been completed.
2. All slopes in cut and embankment sections, ditches and waterways, whether old or newly constructed, shall be satisfactorily cleaned and cleared of obstructions and left in a neat and trim condition. Excavation shall be made in reasonably close conformity with the lines, grades and requirements indicated in the contract or ordered by the Engineer.
3. The construction area shall be maintained so that it will be drained at all times. Where traffic is maintained, care shall be exercised to keep the portion open to traffic in a satisfactory condition.
4. All suitable material removed from excavation shall be used in the formation of embankments as indicated on the plans or as directed by the Engineer. Any excavation that cannot be incorporated in embankments shall be disposed of as directed and no material shall be wasted without permission of the Engineer.
5. The Contractor shall be responsible for the stability of all constructed embankments and shall replace at his or her own expense any portions which have become displaced.
6. Unless authorized by the Engineer, borrow material shall not be placed until all suitable material has been excavated and placed in the embankments except when Sand Borrow or Granular Borrow is called for on the plans or when Granular Borrow is required by the Engineer for use under embankments or used with material from excavation in making embankments.

EXCAVATION

1. Any loose material resulting from breakage and slides shall be removed and disposed of as directed by the Engineer.

2. Excavation shall be sorted so that only clean non-frost susceptible soils are placed in embankments beneath the travelled way.

DISPOSAL OF SURPLUS MATERIAL

1. All surplus excavation and waste material shall be used to the extent possible to uniformly flatten slopes, or be deposited in such places within the project confines as may be indicated on the plans or as directed by the Engineer in writing. Excavated material shall not be wasted unless authorized by the Engineer. Compaction requirements for surplus or waste material used to flatten slopes outside the embankment limits shown on the plans may be waived; however, placement procedures shall insure a stable fill slope.

EMBANKMENTS

1. Preparation of Embankment Area - When embankments are to be made on a hillside, the slope of the original ground on which the embankments are to be constructed shall be stepped and properly drained as the fill is constructed.
2. Use of Materials - The excavated rock, ledge, boulders and stone, except where required in the construction of other items or otherwise directed, shall be used in the construction of embankments to the extent of the project requirements and, generally, shall be placed so as to form the base of an embankment.

Frozen material shall not be used in the construction of embankments, nor shall the embankments or successive layers of the embankments be placed upon frozen material. Placement of material other than rock shall stop when the sustained air temperature, below 32°F, prohibits the obtaining of the required compaction. If the material is otherwise acceptable, it shall be stockpiled and reserved for future use when its condition is acceptable to the Engineer for use in embankments.

The Engineer may require certain select material from excavation or borrow to be used adjacent to structures to obtain the required compaction or to protect them from damage.

When shown on the plans, certain portions of rock excavation may be reserved for special use such as rock fill, for embankment construction at locations below high water, or at locations susceptible to erosion.

3. Procedure for Placing and Spreading - When a road or an embankment is to be constructed across open water or across swampy, wet ground, the Contractor shall remove the full depth of any muck or other unsuitable soils and the first layer of the fill shall be rock or material meeting the requirements for Granular Borrow.

When trucks are used to place earth from excavation or borrow, the material shall be deposited on the layer of embankment being constructed, bladed or dozed into place, and

shaped and compacted. Dumping directly onto previously constructed layers will not be permitted.

Embankments of either earth or rock material shall be placed in horizontal layers of uniform thickness and across the full section width. When it is impractical to construct a layer full width across an embankment, partial width layers may be authorized, providing the full width procedure is resumed as soon as practical. Logs, stumps, waste material and oversized cobblestones or boulders shall not be placed within the structural embankment area. They may be placed outside the structural embankment area at locations approved by the Engineer or when authorized, disposed of as surplus material. Initial layers shall begin at the deepest part of the fill. Except for the first layer of fill over swampy ground and cleared areas, the loose layer thickness shall be limited to 8 inches. When conditions necessitate, the engineer may authorize layers in excess of 8 inches but not more than 24 inches. The Contractor will, at his or her expense, make all necessary excavations up the two feet deep so that the engineer can determine moisture, density and stability.

Effective spreading equipment shall be used on each layer to obtain uniform thickness. Cobblestones or boulders having a least dimension greater than the loose layer thickness being placed shall be removed prior to compaction. Each layer shall be compacted as specified, and, if necessary, stabilized prior to a successive layer being placed. Each layer shall be kept crowned to shed water. As the compaction of each layer progresses, continuous leveling and manipulating will be required to assure uniform density, a uniform and satisfactory moisture content, and acceptable stability. The last lift constructed each day shall be graded, crowned and rolled to insure adequate drainage.

When A4, A5, A6 or A7 cohesive soils have excess moisture and cannot effectively be air dried or dried by manipulation, The Contractor may layer or mix the material with dry A1, A2 or A3 granular soils in order to obtain acceptable compaction and stability. The Contractor is responsible for making prudent use of available granular excavation from the project prior to being authorized the use of Granular Borrow. The combined loose thickness of mixed or layered materials prior to compaction shall not exceed 16 inches.

If, during the construction of the embankments, serious bulging, cracking or unstable movement occurs, the placing of the fill material to stopped, retarded, or corrected to allow the material to stabilize as directed by the Engineer. Generally, rutting, rolling, shoving or other displacement in excess of 6 inches under the action of construction equipment will be considered evidence of stability problems.

When soft or wet clay or silt excavation is being used between layers of reasonably clean stable rockfill, the rock embankment layers shall not exceed two feet in loose measurement and the clay or silt layers shall not exceed eight inches in loose measurement.

4. Compaction - each layer between the design embankment limits shown on the plans shall be uniformly compacted by the use of compaction equipment. Each layer shall be compacted to not less than 95% of material's maximum dry density determined by

AASHTO Standard Method of Test, T-99, Method C. Field density determination will be made in accordance with AASHTO Standard Methods of Test, T-191 (sand cone method), T-238 (nuclear method) or other approved procedures. Field moisture determination will be made in accordance with AASHTO Standard Method of Test T-99, or measured in accordance with AASHTO T-239 (nuclear method). Locations within the embankment limits where waste materials have been placed shall be compacted to the extent that stability is assured.

All fill material shall be compacted at a moisture content determined by the Engineer to be suitable for obtaining the required density. In no case, shall the moisture content in each layer under construction be more than two percent above the optimum moisture content, and shall be less than that quantity that will cause the embankment to become unstable during compaction. Sponginess, shoving or other displacement under heavy equipment shall be considered prima facie evidence for an engineering placement of material in the area affected shall be stopped or retarded to allow the material to stabilize.

When moisture content of the material in the layer under construction is less than the amount necessary to obtain satisfactory compaction by mechanical compaction methods, water shall be added by pressure distributors or other approved equipment; water may also be added in excavation or borrow pits. The water shall be uniformly and thoroughly incorporated into the soil by disking, harrowing, blading or by other approved methods. This manipulation may be omitted for sands and gravels. When the moisture content of the material is in excess of two percent above the optimum moisture content, dry material shall be thoroughly incorporated into the wet material, or the wet material shall be aerated by disking, harrowing, blading, rotary mixing, or by other approved methods; or compaction of the layer of wet material shall be deferred until the layer has dried to the required moisture content by evaporation.

The density requirements will not apply to those portions of embankments constructed of material so coarse that it cannot be satisfactorily tested with conventional density testing apparatus. Material having a gradation with more than 35 percent retained on the No. 4 sieve will, generally, be considered too coarse for conventional density testing. In lieu thereof, the material shall be compacted to the satisfaction of the Engineer.

In areas inaccessible to power rolling, the embankment material shall be placed in uniform horizontal layers of not more than six inches in depth and compacted by means of approved mechanical tampers to the density requirements herein specified. The use of hand tamps will not be permitted.

SUBGRADE

1. The subgrade shall be constructed in close conformity with the lines, grades and cross section shown on the plans. After all drainage structures and piping have been installed and the subgrade has been shaped correctly, it shall be brought to a firm, unyielding surface compacted to attain at least 95 percent of the maximum dry density. This density shall be

determined by the Standard Method of test for the Moisture-Density Relations of Soils, AASHTO T-99, Method C.

A power roller or other approved equipment shall be used during the grading to obtain the specified cross section.

Areas of soft, yielding or other unsuitable material that will not compact readily shall be removed and replaced with a suitable material and properly compacted as directed by the Engineer.

All loose rock or boulders encountered at subgrade in the earth excavation shall be removed or broken off to a depth not less than 12 inches below the subgrade. Within the area to be lined with fabric, no stones larger than 1/2" in diameter may be in the top 6" of subgrade material.

In excavation areas, the ground shall not be excavated or disturbed below the subgrade except as shown on the plans or required in the special provisions, or as ordered by the Engineer. All ditches and drains shall be constructed so they will effectively drain the construction area before the placement of any subbase or surface course material. In handling materials, tools and equipment, the Contractor shall protect the subgrade from damage. Vehicles should not travel in a single track and form ruts. If ruts are formed, the subgrade shall be reshaped and compacted and any pockets of clay, sand or soft material that may have been left in the subgrade shall be removed and replaced with approved material and properly compacted at the Contractor's expense. The subgrade shall be kept in such condition that it will drain. Subbase, base or surface material shall not be deposited on the subgrade until the subgrade has been checked and approved by the Engineer. After the subgrade has been approved, hauling shall not be done nor equipment moved over the subgrade which will distort the cross section.

If any in-place material becomes contaminated by the Contractor's operations so as to no longer meet specifications, the Engineer may order that material to be removed and replaced at the contractor's expense.

A tolerance of 1/2 inch above or below the finished subgrade will be allowed provided that this 1/2 inch above or below subgrade is not maintained for a distance longer than 50 feet, and that the required cross section is maintained. Where placement of the subbase is not part of the work, a tolerance of one inch above or below the finished subgrade will be allowed, provided that this one inch above or below subgrade is not maintained for a distance longer than 50 feet, and that the road cross section is maintained.

FIELD QUALITY CONTROL

1. Secure the Engineer's inspection and approval of subgrades and fill layers before subsequent construction is permitted thereon.

2. Provide at least the following tests to the approval of the Engineer:
 1. At paved areas, at least one field density test for every 10,000 sq ft of paved area, but not less than three tests;
 2. In each compacted fill layer, one field density test for every 2000 cubic yards of fill material placed, but not less than one per lift.
3. If, in the Engineer's opinion based on reports of the testing laboratory, subgrade or fills which have been placed are below specified density, provide additional compacting and testing under the provisions of these Specifications.

MAINTENANCE

1. Protection of newly graded areas:
 - a. Protect newly graded areas from traffic and erosion, and keep free from trash and weeds;
 - b. Repair and re-establish grades in settled, eroded, and rutted areas to the specified tolerances.
2. Where completed compacted areas are disturbed by subsequent construction operations or adverse weather, scarify the surface, reshape, and compact to the required density prior to further construction.

2.2 CONTROLLED BLASTING, EARTH AND ROCK EXCAVATION

A. *DESCRIPTION OF WORK*

1. The work to be done under this section includes:

Furnishing all labor, equipment, materials, and services, and performing operations required to excavate rock as specified utilizing controlled blasting techniques such that resulting ground vibrations are consistently maintained below the maximum levels specified in this Section.

2. Protecting new and existing construction, workers, owner, and the general public from damage or injury from improper handling of explosives, flyrock, and excessive ground vibrations.
3. Furnishing, installing, and implementing an audible warning system to indicate impending blasting and familiarizing workers, architect, owner, and the general public with the system implemented.
4. Conducting blasting monitoring as required to excavate rock utilizing the blast monitoring procedures and equipment specified in this Section.

B. DEFINITIONS

1. Controlled blasting: Shall be considered to mean excavation in rock in which the various elements of the blast, including hole size, position, alignment, depth, spacing, burden, charge size, distribution, and delay sequence are carefully controlled to excavate the rock to the desired lines with a relatively uniform surface and minimum overbreak and fracture of rock beyond the design excavation limits and to maintain resulting ground vibrations within specified limits.
2. Earth: All excavated materials not defined as rock.
3. Flyrock: Fractured rock propelled through the air resulting from blasting if not prevented by use of blasting mats.
4. Geophone or vibration transducer: A sensor used to monitor ground vibrations (particle velocity components).
5. Grades or elevations: The design vertical levels to which excavation shall be conducted and thereby define the design vertical limits of excavation. The actual vertical limits of excavation will be determined by the amount of overbreak below the design grades after removal of overbreak and cleaning of the resulting rock surface as specified.
6. Overbreak: The excess amount of rock removed by and/or resulting from blasting outside beyond the A-line or below the design excavation grades indicated on the drawings.
7. Peak particle velocity: The maximum of any one of the three mutually perpendicular ground motion velocity components of a vibration measured in directions vertical, radial, and perpendicular to the vibration source.
8. Rock: Material which is geologically classified as intact, untransported rock, and requires systematic drilling and blasting for removal. Rock does not include boulders or loose rock fragments less than one (1) cubic yard in volume.
9. Seismograph: An instrument used to record the magnitude and frequency of ground vibrations sensed by a geophone.

*C. QUALITY ASSURANCE**1. Qualifications*

A. The Contractor shall refer, in this specification section, to a qualified professional licensed blasting contractor with a minimum of 5 years experience in the design, review, evaluation, and actual field experience in blasting operations. The blasting Contractor shall design, supervise, and conduct test blasts until regular production controlled blast patterns are developed that produce the required performance specified hereinafter while meeting the requirements for vibrations control. The Contractor shall assign an experienced, qualified Superintendent to be

on the job site at all times to review the blasting operations and direct such changes in the blasting operation meeting the requirements of these Specifications. The Superintendent shall have a minimum of 5 years of experience in field blasting work.

B. All blasting shall be conducted by persons qualified and experienced in drilling and controlled blasting procedures for rock excavation of the types required. Persons responsible for blasting shall be licensed blasters in the State of Vermont and shall have had acceptable experience in similar excavations in rock and controlled blasting techniques. The Contractor must submit a list of previous similar projects he or she and the field Superintendent have done. Drillers shall have demonstrated proficiency in collaring and drilling holes precisely.

2. Codes, Permits, and Regulations:

A. The Contractor shall comply with all applicable laws, rules, ordinances, and regulations of the Federal Govt., the State of Vermont, and the municipality governing the transportation, storage, handling, and the use of explosives. All labor, materials, equipment, and services necessary to make the blasting operations comply with such requirements shall be provided without additional cost to the owner. The Contractor shall comply with the following regulations:

1. Vermont Department of Labor and Industry and the Vermont Agency of Human Services as promulgated by the Occupational Safety and Health Administration, United States Department of Labor, VOSHA Safety and Health Standards for Construction; "Subpart U-Blasting and the Use of Explosives" with amendments as of March 1, 1979, with any current revisions.

2. Code for the Manufacture, Transportation, Storage, and Use of Explosives and Blasting Agents (N.F.P.A. No. 495).

B. The Contractor shall obtain and pay for all permits and licenses required to complete the work of this Section.

C. In case of conflict between regulations or between regulations and Specifications, the Contractor shall comply with the strictest applicable code, regulation, or Specifications.

3. Blasting Limit Criteria:

A. Peak Particle Velocity Limits:

1. The Contractor shall conduct all blasting in such a manner that the resulting peak particle velocity does not exceed 2.0 inch per second at the ground line adjacent to existing structures in the vicinity of the project.

4. Blasting Monitoring:

A. The Contractor shall monitor peak particle velocity resulting from all blast rounds fired for the project as required.

B. The Contractor shall permit the Engineer to utilize the Contractor's blast monitoring equipment to conduct a test calibration at any time during the blast monitoring.

5. Blast Monitoring Reports:

A. Following each blast, a Blast Monitoring Report shall be submitted to the Engineer within 24 hours of the blast as specified in this Section.

6. Blast Monitoring Instrumentation:

All instrumentation proposed for use on the project shall have been calibrated within the previous six (6) months to a standard which is traceable to the National Bureau of Standards.

7. The Contractor shall cooperate with the Engineer in permitting observation of the Contractor's drilling and loading procedures, as well as in providing detailed information on blasting operations.

8. The Contractor shall be completely responsible for all damages resulting from the blasting operations and shall, as a minimum, take whatever measures are necessary to maintain peak particle velocities within the specified limits, and to minimize damage to rock left in place. Modifications to blasting and excavation methods required to meet these requirements shall be undertaken at no cost to the Town.

D. *SUBMITTALS*1. Advance Submittals:

The Contractor shall submit the following information to the Engineer at least three (3) weeks prior to commencing drilling and blasting operations:

A. Sequence of blasting rounds indicating the general method of developing excavations.

B. Specifics of the proposed blasting procedures for round design to be implemented in each individual project area including control blasting technique(s) to be utilized to form the excavation perimeter:

1. Diameter, spacing, burden, depth, and orientation of each blast hole for each round design.

2. Nomenclature and amount (in terms of weight and number cartridges) of explosives and distribution of charge to be used within each hole, on each delay, and the total for the blast.
 3. Nomenclature and type of detonators; delay pattern wiring diagram for the round: type and capacity of firing source, size, type, and location of safety switches and lightning gap.
 4. Type and location of stemming to be used in holes.
 5. Calculations of anticipated vibration levels at nearest adjacent structure.
- C. Methods of matting or covering of the blast area in open excavations to prevent flyrock.
- D. Written evidence of the licensing, experience, and qualifications of the blasters who will be directly responsible for the loading of each shot and for firing it.
- E. Name and qualifications of the Superintendent responsible for directing the blasting. This submittal shall document by project lists and samples of blasting round design calculations that the Contractor and his or her personnel have the required experience in production and control blasting required to adequately and safely perform this work.
- F. Details of an audible advance signal system to be employed at the job site as a means of informing workers, engineer, owner and the general public that a blast is about to occur.
- G. List of instrumentation that the Contractor proposes to use to monitor vibrations.
- H. Recent calibration certificate(s) (within previous six (6) months) for the entire proposed blast monitoring instrumentation. Calibration shall be over the required frequency response ranges specified for blast monitoring instrumentation and to a standard traceable to the National Bureau of Standards.
- I. Submit a shop drawing indicating the location(s), limits, and details of initial test blast(s) proposed by the Contractor to define the relation between charge weight per delay and peak particle velocity level.
3. Progress Submittals:
- A. Within 24 hours following each blast, the Contractor shall submit to the Engineer a Blast Monitoring Report. Each Blast Monitoring Report shall include all of the following applicable items:
1. Report of Blast Monitoring including observer identification, location, time, date, charge weight per delay, total charge weight per blast, monitor instrumentation location and information, particle velocity readings.
 2. Blast Monitoring Location Plan.

3. General Blast Round Design Data including blast pattern, charge weights, and distributions, other pertinent information, and location.

4. Copy of strip chart with calibration and monitoring record marked with the date, time, and location of the blast as well as the monitoring location.

B. Prior to changing the approved blast round designs, the Engineer shall be informed in writing as to the nature of the change and the reasons therefore. Changes shall be subject to the approval of the Engineer. Allow sufficient time for review.

C. - In the event that the Contractor's design round results in ground vibrations which exceed the blasting limit criteria specified in this Section, the Contractor shall immediately revise the round design appropriately and submit the revised round design to the Engineer for approval.

D. Review by the Engineer of blast designs and techniques shall not relieve the Contractor of responsibility for the accuracy, adequacy, and safety of the blasting, exercising proper supervision and field judgement, and producing the results within the blasting limits required by these Specifications.

E. The Contractor shall report to the Engineer in writing all blasting complaints received by the Contractor within 24 hours of receipt. Each blast complainant, time received, date, and time of blast complained about, and a description of the circumstances which led to the complaint.

E. JOB CONDITIONS

1. Blasting:

A. The Contractor shall comply fully with codes, permits, and regulations for the transportation, storage, handling, and use of explosives.

B. No blasting shall be permitted between the hours of 6:00 P.M. and 7:00 A.M. , and all day Saturday, Sunday, and legal holidays. The Contractor shall provide advanced warning prior to detonating a blast. The means of warning shall be acceptable to the Engineer.

C. Prior to construction, the Contractor shall have prepared by an independent consultant satisfactory to the Town, a survey of all existing structures and utilities on the site and within 500 feet of the site. Said survey shall address the structural integrity of all existing structures and utilities. Upon completion of blasting operations, the Contractor shall have prepared by the same independent agency, a survey addressing the structural integrity of the same structures and utilities.

2. Vibration Control:

A. The Contractor shall monitor blasting vibrations for blast(s) during the course of the work as required.

- B. Blasting operations shall be controlled to conform with the requirements in this Section.
- C. If the data indicates that these requirements are not being met, take whatever measures are necessary including reducing the size of the charge, reducing the length of advance, covering, or matting blasts to reduce vibrations to below the maximum permissible levels specified.
- D. The Contractor shall install a signal system between the location of the blasting machine or switch and the monitoring instrument locations so instrument operators may be notified immediately prior to detonation. The signal system shall be relocated whenever the instruments are moved.
- E. The Contractor shall be completely responsible for all damages resulting from the blasting operations and shall take whatever measures are necessary to maintain peak particle velocities within the specified limits, and to minimize damage to rock left in place. Modifications to blasting and excavation methods required to meet these requirements shall be undertaken at no additional cost to the Owner.

F. SAFETY PRECAUTIONS

1. Special Hazards:

The Contractor shall take all special precautions in handling, storage, and wiring necessary to prevent accidental detonation of charges by natural (e.g. thunder-storms) or man made (e.g. power lines, transmitters) sources.

2. Clearing the Danger Area Before Blasting:

No blasting shall be permitted until all personnel in the danger area have been removed to a place of safety. A loud, audible, warning system shall be sounded before each blast. The Contractor shall familiarize all personnel on the project, the Engineer, Town, and the general public with the implemented system. The danger area shall be patrolled before each blast to make certain that it has been completely cleared and guards shall be stationed to prevent entry until the area has been cleared by the blaster following the blast.

- 3. Explosives shall be stored, handled, and employed in accordance with federal, state, and local regulations and in accordance with N.F.P.A. No. 495 as referenced above.
- 4. No explosives, caps, detonators, or fuses shall be stored on the site during non-working hours until a permit has been obtained from the State and Municipality and submitted to the Engineer.
- 5. The Contractor shall be responsible for determining any other safety requirements unique to blasting operations on this particular site so as not to endanger life, property, utility services, any existing or new construction, or any property adjacent to the site.

6. Immediately after each blast, the sidewalls of rock excavations shall be scaled by experienced scalers to dislodge loose or shattered rock liable to fall. Previously excavated portions shall also be routinely tested and scaled.
7. No requirement of, or omission to require, any precautions under this contract shall be deemed to limit or impair any responsibility or obligations assumed by the Contractor under or in connection with a project; and the Contractor shall at all times maintain adequate protection to safeguard the public and all persons engaged in the work, and shall take such precautions as will accomplish such end, without undue interference to the public. The Contractor shall be responsible for and pay for any damage to adjacent structures resulting from work executed under this Section.

G. *MONITORING PROCEDURE*

1. Mount, place, and locate instrumentation as specified in this Section.
2. Align the axis of vibration measurement:
 - Axis 1: Vertical
 - Axis 2: Horizontal, radial direction to the blast location.
 - Axis 3: Horizontal, perpendicular to the radial direction.
3. Set the strip chart(s) speed in accordance with instrumentation manufacturer's recommendations.
4. Make a calibration strip chart before blast detonation in accordance with instrumentation manufacturer's recommendations.
5. Clearly label the strip chart with calibration levels, control settings, location, time, and date of blast.
6. Coordinate closely with the blaster such that the strip chart is advancing at the time the blast is detonated.
7. During the measurement period, observe instrumentation to ensure that recorded vibrations correspond to blasting and not some other source.

2.3 TRENCHING, BACKFILLING, AND COMPACTING

A. *GENERAL*

DESCRIPTION

1. Work included: Trench, backfill, and compact as specified herein and as needed for installation of underground pipes, conduits, cables, wires or other utilities, manholes, catch basins, associated with the Work.

QUALITY ASSURANCE

1. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.
2. Use equipment adequate in size, capacity, and numbers to accomplish the work in a timely manner.
3. In addition to complying with requirements of governmental agencies having jurisdiction, comply with the directions of the soil engineer.

B. PRODUCTS

SOIL MATERIALS

1. Fill and backfill materials:
 - a. Provide soil materials free from organic matter and deleterious substances, containing no rocks or lumps over 6" in greatest dimension, and with no more than 15% of the rocks or lumps larger than 2-3/8" in their greatest dimension.
 - b. Fill material is subject to the approval of the soil engineer, and is that material removed from excavations or imported from off-site borrow areas, predominantly granular, non-expansive soil free from roots and other deleterious matter.
 - c. Do not permit rocks having a dimension greater than 1" in the upper 12" of fill.
 - d. Cohesionless material used for backfill: Provide sand free from organic material and other foreign matter, and as approved by the soil engineer.

OTHER MATERIALS

1. Provide other materials, not specifically described but required for a complete and proper installation, as selected by the Contractor subject to the approval of the Engineer.

C. EXECUTION

SURFACE CONDITIONS

1. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

PROCEDURES

1. Utilities:
 - a. The Contractor shall contact all utilities before excavating to verify the location of any underground lines. The Contractor shall notify "Digsafe" prior to any excavation.
 - b. Unless shown to be removed, protect active utility lines shown on the drawings or otherwise made known to the Contractor prior to trenching. If damaged, the Contractor shall repair or replace at no additional cost.
 - c. If active utility lines are encountered, and are not shown on the Drawings or otherwise made known to the Contractor, promptly take necessary steps to assure that service is not interrupted.
 - d. If service is interrupted as a result of work under this Section, immediately restore service by repairing the damaged utility.
 - e. If the existing utilities are found to interfere with the permanent facilities being constructed under this Section, immediately notify the Engineer and secure his or her instructions.
 - f. Do not proceed with permanent relocation of utilities until written instructions are received from the Engineer.
2. Protection of persons and property:
 - a. Barricade open holes and depressions occurring as part of the Work, and post warning lights on property adjacent to or with public access.
3. Dewatering:
 - a. Remove all water, including rain water, encountered during trench and sub-structure work to an approved location by pumps, drains, and other approved methods.
 - b. Keep trenches and site construction area free from water.
4. Use means necessary to prevent dust becoming a nuisance to the public, to neighbors, and to other work being performed on or near the site.
5. Maintain access to adjacent areas at all times.

TRENCHING

1. Comply with pertinent provisions of this Section.
2. Provide sheeting and shoring necessary for protecting of the Work and for the safety of personnel.
 - a. Prior to backfilling, remove all sheeting.
 - b. Do not permit sheeting to remain in the trenches except when, in the opinion of the Engineer, field conditions or the type of sheeting or methods of construction such as use of concrete bedding are such as to make removal of sheeting impracticable. In such cases, the Engineer may permit portions of sheeting to be cut off and remain in the trench.

3. Open cut:
 - a. Jack or bore for all new pipelines under existing paved Town roads or streets.
 - b. If conditions at the site prevent jacking or boring, and if approved by the Public Works Director, trenching may be used.
 - c. Short sections of a trench may be tunneled if, in the opinion of the Town Engineer, the pipe can be installed safely and backfill can be compacted properly into such tunnel.
 - d. Where it becomes necessary to excavate beyond the limits of normal excavation lines in order to remove boulders or other interfering objects, backfill the voids remaining after removal of the objects as directed by the soil engineer.
 - e. When the void is below the subgrade for the pipe or utility bedding, use suitable earth materials and compact to the relative density directed by the soil engineer, but in no case to a relative density less than 90%.
 - f. When the void is in the side of the pipe or utility trench, use suitable earth or sand compacted or consolidated as approved by the soil engineer, but in no case to a relative density less than 80%.
 - g. Remove boulders and other interfering objects, and backfill voids left by such removals.
 - h. Excavating for appurtenances:
 1. Excavate for manholes and similar structures to a distance sufficient to leave at least 12" clear between outer surfaces and the embankment or shoring that may be used to hold and protect the banks.
 2. Overdepth excavation beyond such appurtenances that has not been directed will be considered unauthorized. Fill with sand, gravel, or high slump concrete as directed by the soil engineer.
4. Trench to the minimum width necessary for proper installation of the utility, with sides as nearly vertical as possible. Accurately grade the bottom to provide uniform bearing for the utility.
5. Depressions:
 - a. Dig bell holes and depressions for joints after the trench has been graded. Provide uniform bearing for the pipe on prepared bottom of the trench.
 - b. Except where rock is encountered, do not excavate below the depth indicated or specified.
 - c. Where rock is encountered, excavate rock to a minimum overdepth of 4" below the trench depth indicated or specified.
6. Where trenching occurs in existing lawns, remove turf in sections and keep damp. Replace turf upon completion of the backfilling.
7. Cover:
 - a. Provide minimum trench depth indicated below to maintain a minimum cover over the top of the installed utility item below the finish grade.
 1. All areas:

(a) Sanitary sewers:	54"
(b) Storm drains:	36"

2. All areas:
 - (a) Water lines: 72"

BACKFILLING

1. General:
 - a. Do not completely backfill trenches until required pressure and leakage tests have been performed, and until the utilities systems as installed conform to the requirements specified in the pertinent Sections of these Specifications.
 - b. Except as otherwise specified or directed for special conditions, backfill trenches to the ground surface with selected material approved by the soil engineer.
 - c. Reopen trenches which have been improperly backfilled, to a depth as required for proper compaction. Refill and compact as specified, or otherwise correct to the approval of the soil engineer.
 - d. Do not allow or cause any of the work performed or installed to be covered up or enclosed by work of this Section prior to required inspections, tests, and approvals.
 - e. Should any of the Work be so enclosed or covered up before it has been approved, uncover all such Work and, after approvals have been made, refill and compact as specified, all at no additional cost to the Owner.
2. Lower portion of trench:
 - a. Deposit approved backfill and bedding material in layers of 6" maximum thickness, and compact with suitable tampers to the density of the adjacent soil, or grade as specified herein, until there is a cover of not less than 24" over sewers and 12" over other utility lines.
 - b. Take special care in backfilling and bedding operations to not damage pipe and pipe coatings.
3. Remainder of trench:
 - a. Except for special materials for pavements, backfill the remainder of the trench with material free from stones larger than 6" or 1/2 the layered thickness, whichever is smaller, in any dimension.
 - b. Deposit backfill material in layers not exceeding the thickness specified, and compact each layer to the minimum density directed by the soil engineer.
4. Adjacent to buildings: Mechanically compact backfill within ten feet of buildings.
5. Consolidation of backfill by jetting with water may be permitted, when specifically approved by the soil engineer, in areas other than building and pavement areas.

PIPE JACKING OR BORING

1. The Contractor will install steel pipe casings, tongue-and-groove reinforced concrete pipes, and steel pipes under existing roads or pavements by jacking or boring into place using procedures approved by the Town Engineer.

TUNNELLING OPERATIONS

1. The Contractor may, at his or her option, tunnel pipes into position using procedures approved by the Town Engineer.

FIELD QUALITY CONTROL

1. The Town Engineer will inspect and approve open cuts, trenches, jacking, boring and tunneling before installation of utilities for the following:
 - a. Assure that trenches are not backfilled until all tests have been completed;
 - b. Check backfilling for proper layer thickness and compaction;
 - c. Verify that test results conform to the specified requirements, and that sufficient tests are performed;
 - d. Assure that defective work is removed and properly replaced.

2.4 DRAINAGE GEOTEXTILES

A. *DESCRIPTION*

This work shall consist of furnishing and placing geotextiles for drainage applications.

B. *MATERIALS*

The geotextile shall consist of a material composed of at least 85 percent by weight of polyolefins, polyesters, or polyamides. The geotextile shall be resistant to chemical attack, rot and mildew, and shall have no tears or defects which adversely alter its physical properties. The fabric shall meet the physical requirements of Table 1.

C. *CONSTRUCTION REQUIREMENTS/INSTALLATION*

1. Shipment and Storage: The geotextile shall be kept dry and wrapped such that it is protected from the elements during shipping and storage. At no time shall the geotextile be exposed to ultraviolet light for a period exceeding fourteen days. The fabric shall be labeled as per ASTM-D-4873.
2. Geotextile Placement: Prior to placement of the geotextile the surface will be prepared to a smooth condition free of debris, depressions, or obstructions which may damage the geotextile. The geotextile shall be placed in the trench, followed by the aggregate which should be placed so as to prevent damage to the geotextile. The geotextile shall be overlapped twelve inches or the full width of the trench, whichever is less, at the top of the trench. Fill material will be placed over the fabric and compacted to hold the fabric in place. Successive pieces of geotextile shall be overlapped a minimum of twelve inches in the direction of flow. Any damage to the geotextile shall be repaired by placing a patch extending three feet in all directions beyond the damaged area.

TABLE 1
PHYSICAL REQUIREMENTS¹
DRAINAGE GEOTEXTILES²

Property ³	Class A ⁴	Class B ⁵	Test Method
Tensile Strength - lbs.	180	80	ASTM D 4632
Elongation - %	N/A	N/A	ASTM D 4632
Puncture Strength - lbs.	80	25	ASTM D 4833
Burst Strength - lbs.	290	130	ASTM 3786
Trapezoidal Tear	50	25	ASTM D 4533
Apparent Opening Size	70 min.	70 min.	ASTM D 4751
Permittivity, gal/min/ft ²	70	70	ASTM D 4491
Ultraviolet Degradation ⁶ - %	70	70	ASTM D 4355

1. Acceptance of geotextile material shall be determined according to ASTM D 4759.
2. Contracting agency may require a letter from the manufacturer certifying that its geotextile meets specification requirements.
3. Minimum - Use value in weaker principal direction. All numerical values represent minimum average roll values (i.e., test results from any sampled roll in a lot shall meet or exceed the minimum values in the table). Stated values are for non-critical, non-severe applications. Lots sampled according to ASTM D 4354.
4. Class A Drainage applications are for fabrics where installation stresses are more severe than Class B applications, i.e., very coarse sharp angular aggregate is used, a heavy degree of compaction (95% AASHTO T99) is specified or depth of trench is greater than 10 feet.
5. Class B Drainage applications are those where fabric is used with smooth graded surfaces having no sharp angular projections, no sharp angular aggregate is used; compaction requirements are light, (<95% AASHTO T 99), and trenches are less than 10 feet in depth.
6. Percent of minimum tensile strength (ASTM-D-4632) retained after weathering per ASTM-D-4355 for 150 hrs.

2.5 EROSION CONTROL GEOTEXTILES

A. *DESCRIPTION*

This work shall consist of furnishing and placing geotextiles for erosion control.

B. *MATERIALS*

The geotextile shall consist of a material composed of at least 85 percent by weight of polyolefins, polyesters, or polyamides. The geotextile shall be resistant to chemical attack, rot and mildew, and shall have no tears or defects which adversely alter its physical properties. The fabric shall meet the physical requirements of Table 2.

C. *CONSTRUCTION REQUIREMENTS/INSTALLATION*

1. Shipment and Storage: The geotextile shall be kept dry and wrapped such that it is protected from the elements during shipping and storage. At no time shall the geotextile be exposed to ultraviolet light for a period exceeding fourteen days. The fabric shall be labeled as per ASTM-D-4873.
2. Placement of Geotextile: Unless otherwise specified, the geotextile shall be overlapped a minimum of two feet at all longitudinal and traverse joints, or the geotextile shall be sewn. If overlapped, the geotextile shall be placed so that the upstream sheet overlaps the downstream sheet. For placement on slopes, each strip shall overlap the next downhill strip. The geotextile shall be anchored using key trenches or aprons at the crest and toe of the slope. Pins, usually eighteen inches in length, may be helpful in securing the geotextile during installation.
3. Placement of Riprap or Aggregate: Placement of riprap will begin at the toe of the slope and proceed up the slope. The riprap shall be placed so as to avoid damage to the geotextile, as approved by the Town Engineer. Stones weighing in excess of 100 pounds shall not be allowed to roll downslope. Lower drop heights may be required, as directed by the Town Engineer, if damage to the geotextile is evident.

TABLE 2
PHYSICAL REQUIREMENTS¹ - EROSION CONTROL GEOTEXTILES²

Property ³	Unprotected ⁴	Protected ⁵	Test Method
Tensile Strength - lbs.	200	90	ASTM D 4632
Elongation - %	15	15	ASTM D 4632
Puncture Strength - lbs.	80	40	ASTM D 4833
Burst Strength - lbs.	320	140	ASTM 3786
Trapezoidal Tear	50	30	ASTM D 4533
Apparent Opening Size	> #30 Sieve ⁷	> #30 Sieve ⁷	ASTM D 4751
Permittivity, sec ⁻¹	.5	.5	ASTM D 4491
Ultraviolet Degradation ⁶ - %	70	70	ASTM D 4355
Seam Strength - lbs.	180	80	ASTM D 4632

1. Acceptance of geotextile material is to be determined according to ASTM-D-4759.
2. Contracting agency may require a letter from the manufacturer certifying that its geotextile meets specification requirements.
3. Minimum - Use value in weaker principal direction. All numerical values represent minimum average roll values (i.e., test results from any sampled roll in a lot shall meet or exceed the minimum values in the table). Stated values are for non-critical, non-severe conditions. Lot sampled according to ASTM D 4354.
4. Unprotected Erosion Control applications are those where fabrics are used under conditions where installation stresses are more severe than class B, i.e., stone placement height should be less than 3 feet and stone weights should not exceed 250 pounds.
5. Protected Erosion Control applications are those where fabrics are used in structures or under conditions where the fabric is protected by a sand cushion or by "zero drop height" placement of stone.
6. Percent of minimum tensile strength (ASTM-D-4632) retained after weathering per ASTM 4355 for 500 hours.
7. Apparent Opening Size
 1. Soil with 50% or less particles by weight passing US No. 200 Sieve, AOS less than 0.6mm (greater than #30 US Std. Sieve)
 2. Soil with more than 50% particles by weight passing US No. 200 Sieve, AOS less than 0.297mm (greater than #50 US Std. Sieve)

2.6 SEPARATION GEOTEXTILES

A. *DESCRIPTION*

This work consists of furnishing and placing a geotextile to prevent mixing of base and subgrade materials in roadways and in other applications where it is necessary to prevent mixing of dissimilar materials.

B. *MATERIALS*

The geotextile shall consist of a material composed of at least 85 percent by weight of polyolefins, polyesters, or polyamides. The geotextile shall be resistant to chemical attack, rot and mildew, and shall be resistant to chemical attack, rot and mildew, and shall have no tears or defects which adversely alter its physical properties. The fabric shall meet the requirements of Table 5. The choice of a geotextile for this application is determined by the ability of the geotextile to survive installation stresses. These stresses include subgrade strength, wheel loads, and lift thickness as shown in Table 4.

C. *CONSTRUCTION REQUIREMENTS/INSTALLATION*

1. Shipment/Storage: The geotextile shall be kept dry and wrapped such that it is protected from the elements during shipping and storage. At no time shall the geotextile be exposed to ultraviolet light for a period exceeding fourteen days. The fabric shall be labeled as per ASTM-D-4873.
2. Site Preparation: The area should be cleared and any debris or obstructions which may damage the geotextile shall be removed. Trees and large bushes should be cut at ground level, and native vegetation and roots should be left in place.
3. Fabric Placement: The geotextile shall be unrolled on the subgrade and laid smooth without excessive wrinkles. The geotextile shall not be dragged across the subgrade. The geotextile shall be overlapped or sewn depending upon subgrade conditions as shown in Table 3.
4. Placement of Aggregate: Aggregate base shall be placed on the geotextile in lifts of not less than six inches. The aggregate shall be placed by back dumping and spreading of the aggregate material on the geotextile. Traffic shall not be permitted directly on the geotextile, and sudden stops or turns by equipment operating on aggregate placed over the geotextile shall be avoided. Pins or piles of fill can be used to hold the geotextile in place while being covered. End dumping or tail gate dumping of aggregate on the geotextile will not be permitted. Backfill shall be compacted as specified on the plans or as directed by the Town Engineer.

Any damage occurring during placement of the aggregate must be repaired immediately. The backfill shall be removed over the damaged area so as to allow placement of a patch extending three feet on all sides beyond the damaged area, followed by replacement of the fill material.

Table 3

OVERLAP REQUIRED

CALIFORNIA BEARING RATIO (CBR)	<0.5	0.5-1	1-2	>2
MINIMUM OVERLAP	Field Sew	3 ft.	2 ft.	1.5 ft.

Table 4

CONSTRUCTION SURVIVABILITY RATINGS

SUBGRADE CBR	1		1-2		>2	
TIRE PRESSURE (PSI)	<50	>50	<50	>50	<50	>50
COVER THICKNESS (IN)						
6	NR		H		M	
12	NR	H	M		M	
18	H	M	M		M	

H = High

M = Medium

NR = Not Recommended

TABLE 5
PHYSICAL REQUIREMENTS¹
SEPARATION GEOTEXTILES²

Property ³	Survivability Medium ⁵	Survivability High ⁵	High Flow/ Groundwater ⁶	Test Method
Tensile Strength - lbs.	180	270	270	ASTM D 4632
Elongation - %	15	15	15	ASTM D 4632
Puncture Strength - lbs.	70	100	100	ASTM D 4833
Burst Strength - lbs.	400	600	600	ASTM 3786
Trapezoidal Tear	70	100	100	ASTM D 4533
Apparent Opening Size	> #30 Sieve ⁷	> #30 Sieve ⁷	min #40 Sieve	ASTM D 4751
Permittivity, sec ⁻¹	.02	.02	.5	ASTM D 4491
Ultraviolet Degradation ⁴ - %	70	70	70	ASTM D 4355

1. Acceptance of geotextile material is to be determined according to ASTM-D-4873.
2. Contracting agency may require a letter from the manufacturer certifying that its geotextile meets specification requirements.
3. Minimum - Use value in weaker principal direction. All numerical values represent minimum average roll values (i.e., exceed the minimum values in the table). Stated values are for non-critical, non-severe conditions. Lot sampled according to ASTM-D-4354.
4. Percent of tensile strength retained (ASTM-D-4632) after conditioning for 500 hours per ASTM 4355.
5. Construction survivability as defined in Table 2.
6. High flow/high groundwater properties refers to those site conditions where groundwater flow through the fabric exceeds that which can be managed with conventional stabilization (separation) fabrics. These conditions are usually evaluated on a qualitative basis, with the condition that the flow rate through the fabric should generally be an order of magnitude greater than that of the soil or base material being filtered.
7. Apparent Opening Size
 1. Soil with 50% or less particles by weight passing US No. 200 Sieve, AOS less than 0.6mm (greater than #30 US Std. Sieve)
 2. Soil with more than 50% particles by weight passing US No. 200 Sieve, AOS less than 0.297mm (greater than #50 US Std. Sieve)

2.7 TEMPORARY SILT FENCE

A. *DESCRIPTION*

This work consists of furnishing, installing, maintaining, and removing a water permeable filter fence to remove suspended particles from the drainage water.

The quantity of temporary silt fence to be installed will be affected by the actual conditions which occur during the construction of the project. The quality of temporary silt fence may be increased, decreased, or eliminated entirely at the direction of the Town Engineer. Such variations in quantity will not be considered as alterations in the details of construction or a change in the character of the work.

B. *MATERIALS*

1. Posts: Posts shall be a minimum of 4 feet long and either wood or steel posts may be used. Soft wood posts shall be at least three inches in diameter, or nom. 2" x 4" and straight enough to provide a fence without noticeable misalignment. If oak posts are used the size may be reduced to 1-1/2" x 1-1/2" with a minus tolerance of 1/8" providing the cross sectional area is a minimum of 2.25 sq. in. Steel posts shall be round or U.T. or C shaped with a minimum weight of 1.3 pounds per foot, and have projections for fastening the wire to the fence.

2. Geotextile Fabric: Fabric shall be composed of a strong rot-proof synthetic fibers formed into a fabric of either the woven or nonwoven type. The fabric shall contain stabilizer and/or inhibitors to make the filaments resistant to deterioration resulting from exposure to sunlight or heat.

The edges of the fabric shall be finished to prevent the outer yarn from pulling away from the fabric. The fabric shall be free of defects or flaws which significantly affect its physical and/or filtering properties. The fabric shall have a minimum width of 36 inches. Sheets of fabric may be sewn or bonded together. No deviation from any physical requirements will be permitted due to the presence of the seam.

The fabric may be manufactured with pockets for posts, hems with cord or with posts preattached using staples or button head nails.

During all periods of shipment and storage, the fabric shall be wrapped in a heavy-duty protected covering which will protect the cloth from sunlight, mud, dust, dirt, and debris. The fabric shall not be exposed to temperatures greater than 140 degrees F.

The fabric shall meet the physical requirements of Table 6.

3. Fasteners for Wooden Posts:

a. Wire Staples will be a No. 17 gage minimum and shall have a crown at least 3/4 inch wide and legs at least 1/2 inch long. Staples shall be evenly spaced with at least 5 per post.

- b. Nails shall be 14 gage minimum, 1 inch long with 3/4 inch button heads. Nails shall be evenly spaced with at least 4 per post.

C. CONSTRUCTION REQUIREMENTS/INSTALLATION

The Contractor shall install temporary silt fence according to this specification, as shown on the plans or as directed by the Engineer.

1. Installation: A trench four to six inches in depth shall be excavated with equipment such as a trenching machine or motor grader; or, if equipment cannot be operated on the site, by hand.

Post installation shall start at the center of the low point (if applicable) with the remaining posts spaced 6 feet apart. Post shall be installed with at least eighteen inches in the ground. Where an eighteen inch depth is impossible to achieve, the posts should be adequately secured to prevent overturning of the fence due to sediment loading.

Filter fabric shall be attached to the post by wire, cord, pockets, staples, or other acceptable means. The filter fabric shall be installed in such a manner that six to eight inches of fabric is left at the bottom to be buried and a minimum overlap of eighteen inches is provided at all splice joints. The fabric shall be installed in trench such that four to six inches of fabric is against the side of the trench two to four inches of fabric across the bottom in the upstream direction. The trench is then backfilled and compacted so that no flow can pass under the barrier.

At the time of installation, the fabric will be rejected if it has defects, rips, holes, flaws, deterioration, or damage incurred during manufacture, transportation, or storage.

2. Maintenance and Removal: The Contractor shall maintain the silt fence until the project is accepted or until the fence is removed, and shall remove and dispose of silt accumulations at the silt fence when so directed by the Town Engineer. Filter fabric shall be removed and replaced whenever it has deteriorated to such extent that it reduces the effectiveness of the silt fence.

Silt fence shall remain in place unless the Town Engineer directs that it be removed. Silt fence which has been removed will remain the property of the Contractor and may be used at other locations provided it is in a condition acceptable to the Town Engineer. Upon removal of silt fence, the Contractor shall dress the area to give a pleasing appearance.

TABLE 6
PHYSICAL REQUIREMENTS¹
TEMPORARY SILT FENCE GEOTEXTILES²

Property ³	Standard Fence Requirements	High Performance Requirements ⁵	Test Method
Tensile Strength - lbs.	90	Warp 190 Fill 100	ASTM D 4632
Elongation - %	40 max.	40 max.	ASTM D 4632
Permittivity - gal/min/ft ²	15	15	ASTM D 4491
Apparent Opening Size	> #20 Sieve	> #30 Sieve	ASTM D 4751
Ultraviolet Degradation ⁴ - %	70	70	ASTM D 4355

1. Acceptance of geotextile material to be determined according to ASTM D 4759.
2. Contracting agency may require a letter from the manufacturer certifying that its geotextile meets specification requirements.
3. Minimum - Use value in weaker principal direction. All numerical values represent minimum average roll value (i.e., test results from any sampled roll in a lot shall meet or exceed the minimum values in the table) - Stated values are for non-critical, non-severe conditions. Lot sampled according to ASTM D 4354.
4. Percent of minimum tensile strength (ASTM-D-4632) retained after weathering per ASTM 4355 for 500 hours.
5. High performance geotextile should be used on projects requiring high flow rates through fabric or requiring higher strength for sediment retention. Physical requirements for high performance fence are Georgia Department of Transportation requirements with exception of Permittivity. Georgia DOT requirement is 25 gallons/min/ft sq. In addition the geotextile must have tape yarns in one principle direction only.

2.8 UNDERDRAINS:

A. DESCRIPTION

This item shall consist of constructing underdrains using pipe, stone, filter fabric, underdrain outlets, clean outs, and risers in accordance with these specifications and as shown on the accepted drawings or as ordered by the Town Engineer.

B. MATERIALS

Perforated Polyvinyl Chloride (PVC): PVC SDR35 pipe shall conform to AASHTO M278 and ASTM F75B. For pipe sizes 4", 6", and 8" perforations shall be 1/4" diameter holes, 3 1/4" on center, with a total of 4 rows spaced at 90 degrees and 150 degrees. For pipe sizes 10" and larger perforations shall be 1/4" diameter holes, 3 1/4" on center, with a total of 6 rows spaced at 90 degrees, 125 degrees, and 160 degrees.

Perforated Corrugated Steel Pipe: Pipe shall conform to AASHTO M36. Minimum sheet metal thickness required is 0.052 inches for six inch diameter underdrain and 0.064 inches for eight inch diameter or larger. For pipe sizes 4", 6", and 8" perforations shall be 1/4" diameter holes, 3 1/4" on center, with a total of 4 rows spaced at 90 degrees and 150 degrees. For pipe sizes 10" and larger perforations shall be 1/4" diameter holes, 3 1/4" on center, with a total of 6 rows spaced at 90 degrees, 125 degrees, and 160 degrees.

Perforated Corrugated Aluminum Alloy Pipe: Pipe shall conform to AASHTO M196. For pipe sizes 4", 6", and 8" perforations shall be 1/4" diameter holes, 3 1/4" on center, with a total of 4 rows spaced at 90 degrees and 150 degrees. For pipe sizes 10" and larger perforations shall be 1/4" diameter holes, 3 1/4" on center, with a total of 6 rows spaced at 90 degrees, 125 degrees, and 160 degrees.

Stone: Stone fill shall be clean, durable, three-fourths inch to one and one-half inch (3/4" to 1 1/2") stone.

Drainage Fabric: The fabric shall meet the requirement of Section 2.4 - Drainage Geotextiles.

C. CONSTRUCTION METHODS

Trenches for underdrain shall be excavated to the dimensions and grade shown on the plans or as ordered by the Town Engineer. Stone fill shall be placed to a depth of six inches (6") below the bottom of the pipe in conformity with the lines and grades shown on the plans or as directed by the Town Engineer.

Underdrain shall be placed in the center of the trench and firmly embedded in the material. The underdrain trench shall be backfilled to the gravel road base with three-fourths inch to one and one-half inch (3/4" to 1 1/2") clean stone. Placing shall begin at the outlet end and shall proceed

toward the upper end. The under-drain shall be placed with perforations down unless otherwise ordered by the Town Engineer.

The joints between sections shall be made by fitting the ends as tightly as practicable. Corrugated steel or aluminum alloy underdrain shall be joined with an approved coupling. PVC plastic underdrain shall be suitably joined with approved fittings by the same manufacturer. Upgrade ends of all underdrain pipe installations shall be closed with suitable plugs to prevent entry of soil material.

Underdrain cleanouts and cast iron covers shall be installed at locations shown on the plans or as directed by the Engineer. Unless other-wise directed, non-perforated pipe shall be used.

Backfill material shall not be placed directly in the trench by dumping from haul vehicles or by pushing material into trenches by bulldozers, graders, or other equipment. Placing shall be limited to the use of hand shovels, backhoes, front-end loaders, or other similar types of equipment.

Drainage fabric shall be placed in the trench around the stone fill with a twelve inch (12") fabric overlap at the top (see underdrain detail).

2.9 SAND:

A. DESCRIPTION

This item shall consist of a subbase course of sand as approved by the Engineer and constructed on a prepared subgrade in accordance with the sections as shown on the accepted drawings.

B. MATERIALS

Sand shall consist of material free from silt, loam, clay, or organic matter. It shall conform to the Vermont Standard Specifications for Construction for sand cushion, # 703.03. It shall be obtained from approved sources and shall meet the requirements set forth in this table:

Sieve Designation	Percentage By Weight Passing Square Mesh Sieve
2"	100
1 1/2"	90 - 100
1/2"	70 - 100
#4	60 - 100
#100	0 - 20
#200	0 - 8

2.10 GRAVEL BASE - BOTTOM COURSE:**A. DESCRIPTION**

This item shall consist of a base course composed of bank run gravel and filler as approved by the Engineer and constructed on a prepared subgrade in accordance with the sections as shown on the accepted drawings.

B. MATERIALS

All materials shall be secured from approved sources. Such gravel shall consist of hard, durable stones, which show uniform resistance to abrasion and which are intermixed with sand or other approved binding material as directed by the Engineer. It shall meet the requirements of Vermont Standard Specification for Construction, # 704.04, Gravel for Subbase, or as periodically amended. The gravel shall be uniformly graded from coarse to fine and shall meet the grading requirements set forth in this table:

Sieve Designation	Percentage By Weight Passing Square-Mesh Sieve
#4	20 - 60
#100	0 - 12
#200	0 - 6

All bottom course material shall be deposited and spread so as to distribute the material in uniform layers, compacted at optimum moisture content; and the maximum size stone particles shall not exceed two-thirds ($2/3$) of the thickness of the layer being placed.

C. PREPARATION OF SUBBASE

The subbase material shall be placed on a prepared surface with an approved spreader box or by use of some other approved mechanical spreading equipment. The material shall be deposited so as to meet the requirements of the Vermont Standard Specifications for Construction, Section 301, or as periodically amended, and compacted to a 95 percent dry density by the AASHTO- T-99 Method A (Standard Proctor) test. Where there is high groundwater or frost susceptible soils, subbase fabric and underdrains shall be installed beneath the roadway as required on the street details found in Appendix I of these specifications.

2.11 GRAVEL BASE - TOP COURSE:**A. DESCRIPTION**

This item shall consist of an upper course of crusher run gravel to be placed over the bottom course of bank run gravel, which will have been prepared in accordance with these specifications. This upper course shall conform to the following specifications and be placed in accordance with the lines, grades, and typical cross-sections as shown in the accepted drawings. Material shall meet Vermont Standard Specifications for Construction, Item # 704.05, Crushed Gravel for Subbase, or as periodically amended.

B. MATERIALS

All materials shall be secured from approved sources. This gravel shall consist of angular and round fragments of hard durable rock of uniform quality throughout, reasonably free from thin elongated pieces, soft or disintegrated stone, dirt, or other objectionable matter. The grading requirements shall conform to the following table:

Sieve Designation	Percentage By Weight Passing Square Mesh Sieve
2"	100
1 1/2"	90 - 100
#4	30 - 60
#100	0 - 12
#200	0 - 6

This upper course of crushed gravel shall be deposited and spread in a uniform layer and compacted to a 95 percent dry density by the AASHTO-T-99 Method A (Standard Proctor) test.

2.12 BITUMINOUS CONCRETE (ASPHALT) PAVEMENT

A. GENERAL

SUMMARY

1. The work of this section consists of furnishing all labor, materials, tools and equipment necessary to construct all temporary and permanent bituminous bases and surfaces to the dimensions and in the areas shown on the Drawings. The Contractor shall maintain all temporary surfaces to the satisfaction of the Engineer until the permanent surface is constructed.
2. Roadway, drives and parking area subgrade excavation, embankment and fill shall be in accordance with the appropriate portions of the Earthwork Section of these Specifications.

REFERENCE STANDARDS

1. Reference is made in this section to the following standard specifications:
 - a. VAOT Spec. - "Standard Specifications for Highway and Bridge Construction", Department of Highways of the State of Vermont, as adopted March, 1976.
 - b. ASTM - "Standard Specifications for Materials and Testing of the American Society of Testing Materials."

WEATHER LIMITATIONS ON PAVING OPERATIONS

1. Bituminous material shall not be applied between November 1 and May 1. The courses shall not be placed when the air temperature at the paving site in the shade and away from artificial heat is below 40° F. Placing shall not begin until the air temperature is at least 40° F. and rising. The Engineer may authorize in writing construction of bituminous concrete pavements at lower atmospheric temperatures than those specified or may extend the dates of the paving season. No pavement shall be laid in the rain and the underlying course shall be dry during paving operations.
2. Each load shall be covered with canvas or other suitable material of ample size to protect it from the weather. Deliveries shall be made so that spreading and rolling of all mixture prepared for a day's run can be completed during daylight. The mixture shall be delivered to the area to be paved in such a manner that the temperature at the time of dumping into the spreader will not be less than that specified. Hauling over freshly laid material will not be permitted.

SUBMITTALS

1. Contractor shall submit bituminous concrete mix formula for approval prior to commencing paving. The mix formula shall include the temperature range at which the hotmix shall be laid to obtain the optimum compaction.

B. PRODUCTS

MATERIALS

1. Aggregate for Base and Surface Courses
 - a. Aggregate for base and surface courses shall consist of clean, hard, durable particles of crushed stone, gravel, sand and fine mineral particles conforming to "VAOT" Spec. Section 704 as follows:
 1. Base course - Section 704.06, Table 704.06A - Dense Graded Crushed Stone for Subbase.
 2. Surface Course - Section 704.07, Table 704.07A - Crushed Gravel for Sub-Base.

AGGREGATES FOR BITUMINOUS CONCRETE PAVEMENT

1. The aggregates for bituminous concrete pavement shall be crushed stone, crushed gravel and/or sand uniformly graded.
 - a. Coarse aggregate shall conform to Standard Specification for Coarse Aggregate for Bituminous Paving Mixture, ASTM D692-69.
 - b. Fine aggregate shall conform to Standard Specification for Fine Aggregate for Bituminous Paving Mixture, ASTM D1073-69.
 - c. Mineral filler shall conform to Standard Specifications for Mineral Filler for Bituminous Paving Mixture, ASTM D242-64.

ASPHALT CEMENT FOR BITUMINOUS CONCRETE PAVEMENT

1. Asphalt cement for use in the construction of bituminous concrete pavements shall be prepared by refining crude petroleum by suitable methods and shall conform to Standard Specification for Asphalt Cement for Use in Pavement Construction, ASTM D946-69. The grade of asphalt shall be AC5, AC10, or AC20 as directed by the Engineer.

EMULSIFIED ASPHALT

1. Emulsified asphalt shall be used as specified herein or on the Drawings or as directed by the Engineer and shall conform to Standard Specifications for Emulsified Asphalt, ASTM D977-69.

BITUMINOUS CONCRETE

1. The materials for all bituminous concrete shall be as specified herein and as shown on the Drawings. All bituminous Concrete shall be prepared in accordance with standard specifications for Hot-Mixed, Hot-Laid Asphalt Paving Mixtures ASTM D2629-60 which have been prepared in a plant which conforms to ASTM D995-67.
2. Gradation
 - a. The materials shall be combined and graded to the following composition limits by weight:

PERCENTAGE BY WEIGHT PASSING SQUARE MESH SIEVE				
Sieve Size	Type I	Type II	Type III	Type IV
1½"	100			
1"	95-100	100		
¾"	74-86	95-100	100	
½"	60-80	76-88	95-100	100
3/8"	-	62-82	78-90	95-100
#4	35-60	44-62	54-75	62-80
#8	25-45	30-48	39-60	39-60
#16	-	20-38	24-45	24-45
#30	10-25	13-30	14-35	14-35
#50	-	6-22	6-24	6-24
#200	2-6	2-6	2-6	2-6
Total Agg.	94-97	93-97	92-97	92-95
Bitumen (% of Total Mix)	3-6	3-7	3-8	5-8

- b. These gradations taken from Section 406 of the State of Vermont Department of Highways Standards Specifications.
- c. The class and thickness of pavements shall be as shown on the Drawings.

MARKER PAINT

1. Asphalt base paint, as recommended by the Vermont Highway Department Specifications.

C. WORK

BASE AND SURFACE COURSES (GRAVEL BASE)

1. Before any base course material is laid, the subgrade shall be prepared in a proper manner. All embankments shall be constructed as specified in the Earthwork Section of these Specifications and in all cases the top 6 inch layer of subgrade material shall be compacted in such a manner as to secure not less than 95% of the maximum density as determined by the Standard Method of Test for the Moisture-Density Relationship of Soils, AASHTO T-99 Method of Test.

2. All materials used for the construction of the subgrade, base and surface shall be unfrozen and free from organic or other deleterious matter. No subgrade base or surface construction shall take place at temperatures below 40° F unless otherwise approved by the Engineer.
3. Mineral aggregate base and surface courses shall be placed in layers not to exceed 8 inches loose depth and 6 inches compacted depth. Materials for each layer shall be distributed from moving dump trucks, spreader boxes or self propelled spreaders. Material may also be spread by depositing it in one of two windrows and then spreading it with a blade grader.
4. After each layer is placed it shall be compacted with an approved roller weighing not less than 8 tons, or a rubber tired roller approved by the Engineer. Rolling of each layer shall be continued until a firm, solid and unyielding base is established before the next layer is begun. During compaction, the surface shall be graded to obtain a true even surface. Compaction to be the same as described in Paragraph 3.1A.

PLACING BITUMINOUS CONCRETE PAVEMENT

1. Placing Equipment
 - a. The bituminous concrete paver shall be a self-propelled unit with an activated screed or strike-off assembly, the mixture without segregation for the widths and thicknesses required.
 - b. The screed shall be adjustable to provide the desired cross-sectional shape.
 - c. The finished surface shall be of uniform texture and evenness and shall not show tearing, shoving, or pulling of the mixture.
 - d. The machine shall, at all times, be in good mechanical condition and shall be operated by competent personnel.
2. Surface Preparation
 - a. Prior to laying the surface course, the underlying course shall be cleaned of all foreign or objectionable matter.
 - b. If the bottom course of bituminous concrete pavement is left over 30 days, the existing surface shall be cleaned. All longitudinal and transverse joints and all cracks shall be sealed by the application of an approved joint sealing compound before spreading the finish coat. Any large cracks in a bituminous surface shall be thoroughly cleaned and filled with a bituminous material or mixture approved by the Engineer. Emulsified asphalt shall then be applied to the existing pavement in a manner approved by the Engineer.
 - c. Contact surfaces such as curbing, gutters and manholes shall be painted with a thin, uniform coat of Emulsified Asphalt, immediately before the bituminous concrete mixture is placed against them.
 - d. If there are deficiencies in the base course that require corrective action, a bituminous concrete mix which meets the approval of the Engineer shall be used to bring the base course to the designed grade and contour.

3. Delivery

- a. The range of acceptable temperatures of mixture delivered to the spreader shall be not less than 225° F. nor more than 325° F.. Material not within this temperature range shall be rejected.

4. Placing and Finishing

- a. The mechanical spreader shall be adjusted and speed regulated so that the surface of the course will be smooth and of such depth that, when compacted, it will conform to the cross section, grade, and contour shown on the Drawings.
- b. Unless otherwise directed, the placing shall begin along the center line of areas to be paved on a crowned section and on the high side of section with a one-way slope.
- c. The mixture shall be placed in strips having a minimum width of 10 feet, and the 6-inch strip adjacent to the area on which additional material is to be laid shall not be rolled until such additional material is placed, except when the work is to be discontinued.
- d. After the first strips have been placed and rolled, the second strips and succeeding strips shall be placed and rolling shall be extended to include the 6-inches of the first strips not previously rolled. The succeeding strips shall be placed while the unrolled 6-inch section of the adjoining strip is hot and in a readily compatible condition.
- e. Placing of the mixture shall be as continuous as possible.
- f. A sufficient number of experienced shovelers and rakers shall follow the spreading machine, adding hot mixture and raking the mixture as required to produce a course that, when completed, will conform to all requirements specified. In areas where the use of machine spreading is impractical, the mixture may be spread by hand.
- g. The mixture shall be dumped on approved dump boards outside the area to be paved. The mixture shall be distributed into place from the dump boards by means of hot shovels and then spread with hot rakes in a uniformly loose layer of such thickness. The loads shall not be dumped any faster than they can properly be handled by the shovelers and rakers.

COMPACTION OF BITUMINOUS CONCRETE PAVEMENT

1. Compaction shall be done by three wheel rollers or tandem rollers having a gross weight of not less than 8 tons and capable of providing a minimum compactive effect of 250 pounds per inch of width of drive roller. The rollers shall also be equipped with tanks and sprinkler bars for wetting the rollers.
2. Rolling of the bituminous concrete pavement shall begin as soon after placing as the mixture will bear the roller without undue displacement.
3. Rolling will start longitudinally at the extreme sides of the lanes and proceed toward the center of the pavement, over-lapping successive trips by at least 1/2 the width of the rear wheel of the roller. Alternate trips of the roller shall be of slightly different lengths. The initial longitudinal rolling shall be effected by the use of 3 wheel rollers. Tests for conformity with the specified crown, grade and smoothness shall be made by the Contractor

under the supervision of the Engineer immediately after initial compression. Before continuing the rolling, any variations shall be corrected by removing or adding materials as directed. The course shall also be subjected to diagonal rolling using the tandem rollers crossing the lines of the first rolling while the mixture is hot and in a compatible condition. The speed of the rollers shall not exceed 3 miles per hour and shall at all times be slow enough to avoid displacement of the hot mixture. Any displacement of the mixture occurring as the result of reversing the direction of the roller, or from any other cause shall be corrected at once by the use of rakes and fresh mixture applies of mixture removed as required. Rolling shall be continued until all roller marks are eliminated and a density of at least 93 percent of the density of a laboratory specimen of the same mixture, subjected to 50 blows of a standard Marshall hammer, has been obtained for both courses.

4. In all places not accessible to the roller, the mixture shall be thoroughly compacted with hot hand tampers. Hand tampers shall weigh not less than 25 pounds and shall have a tamping face of not more than 50 square inches. Skin patching of an area that has been rolled will not be permitted. Any mixture that becomes mixed with foreign material or in any way defective shall be removed, replaced with fresh mixture and compacted to the density of the surrounding area. The roller shall pass over the unprotected edge of the course only when the laying of the course is to be discontinued for such length of time as to permit the mixture to become cold.

JOINTS IN PAVEMENT

1. Joints between old and new pavements or between successive day's work shall be made so as to insure a thorough and continuous bond between the old and the new pavement. Whenever the spreading process is interrupted long enough for the mixture to attain its initial stability, the paver shall be removed and a joint constructed.
2. Butt joints shall be formed by rutting the pavement in a vertical plane at right angles to the centerline, at a location approved by the Engineer. The butt joint shall be thoroughly coated with Emulsified Asphalt just prior to depositing the paving mixture.
3. Longitudinal joints that have become cold shall be coated with Emulsified Asphalt before the adjacent mat is placed. If they have been exposed to traffic, they shall be cut back to a clean vertical edge prior to painting with the emulsion.

PAVEMENT SURFACE TOLERANCES

1. The surface will be tested by the Engineer using a 16 foot straight-edge at selected locations parallel with the centerline. Any variations exceeding 3/16 of an inch between any two contacts shall be satisfactorily eliminated. A 10 foot straight-edge may be used on a vertical curve. The straight edges shall be provided by the Contractor.

EXISTING PAVING

1. Where new paving adjoins existing roads, extend new paving over existing and level paving to a smooth, hard surface. Installation shall be in full conformity with the local and/or State of Vermont Highway Department requirements.

MARKER PAINTING

1. General - Plain solid lines where indicated on the Drawings in the manner hereinafter specified. Paint lines immediately after all aspects of the paving operations have been completed and before dirt or moisture can accumulate on pavement surfaces.
2. Protection - Install adequate barricades at points where trespassing may occur, immediately after paving is completed so as to prevent vehicles or pedestrians from impeding the painting operation.
3. Method
 - a. Carefully layout and define all painted lines on the surface of the pavement, by means of chalk markings, before painting, and accurately paint all lines within the limits and to the dimensions indicated on the Drawings. All surfaces must be thoroughly cleaned before lines are painted.
 - b. All lines shall be clear and distinct with sharply defined edges. Apply two coats of paint. At least 24 hours shall elapse between the painting of the first and second coats.
4. Removal of Equipment - Upon completion of the painting operation and once the paint has dried, remove all barricades and other debris which has resulted from this operation.

CLEANING

1. Remove all bitumen from exposed surfaces of concrete curbs.
2. Remove all excess bituminous material from the project site.

2.13 CEMENT CONCRETE CURB:**A. DESCRIPTION**

This item shall consist of a Portland cement concrete curb constructed on a prepared subgrade in accordance with these specifications and the cross-section shown on the drawings.

B. MATERIALS

All concrete used in the construction of roadway curbs shall be Air Entrained not less than five percent nor more than seven percent so determined by an air meter approved by the Engineer. This

concrete shall have a 28-day compressive strength of 3,500 psi and shall meet Section 501 of the State of Vermont Standard Specifications for Construction for Class B concrete or as periodically amended.

C. CONSTRUCTION METHODS

Preparation of subgrade: All boulders, organic material, soft clay, spongy material, and any other objectional material shall be removed and replaced with approved material. The concrete curbing shall be built to the required line and grade on a bed of fully compacted gravel a minimum of six inches (6") in depth.

Forms for concrete: The forms shall be of metal or of acceptable planed and matched lumber and of such construction that a smooth surface will be produced. All forms shall be oiled.

Placing and finishing concrete: Just prior to placing the concrete, the subgrade shall be moistened. After being mixed to the proper consistency, the concrete shall be placed in the forms and thoroughly tamped in place so that all honeycombs will be eliminated and sufficient mortar will be brought to the surface. The use of vibrators or other compaction equipment to move the concrete within the forms is not approved.

Immediately upon removal of the forms, the curbing shall be rubbed down to a smooth and uniform finish. No plastering or patching will be allowed. After the forms have been removed, the trench shall be backfilled with approved gravel and fill as needed and thoroughly tamped, care being taken not to affect the alignment or grade of the curbing.

Placement of the concrete by a curb-forming machine shall be allowed.

Expansion and contraction joints: Half inch (1/2") expansion joints shall be placed at intervals of 20 feet. At intervals not greater than 10 feet nor less than five feet, the concrete shall be scored for a depth equal to one-third the total depth of the concrete.

Curing the concrete: When completed, the concrete shall be kept moist for a period of not less than three days or longer if the Engineer deems necessary and shall be protected from the elements in an approved manner. If the Contractor elects, he or she may apply an approved curing compound according to directions of the manufacturer.

Seasonal limits: No concrete shall be poured on a frozen or thawing subgrade during unseasonable weather conditions or when the temperature is 38 degrees Fahrenheit and falling. The Contractor shall record the temperature daily as outlined in the Proposed Recommended Practice - Cold Weather Concreting, ACI 306. In hot weather, the temperature of freshly placed concrete shall not be allowed to exceed 85 degrees Fahrenheit, conforming to ACI 305.

Anti-Spalling Compound: When the initial curing period is over (approximately 28 days after placement), all exposed surfaces shall receive two coats of anti-spalling compound. The surfaces shall be cleaned and then the compound shall be applied; the first coat at a rate of 0.025 gallons per square

yard, the second at a rate of 0.015 gallons per square yard. Anti-spalling compound shall only be applied when the air temperature is above 50 degrees Fahrenheit.

Curb cuts: Each house or business shall be allowed one curb cut unless otherwise approved by the Director of Public Works. Curb cuts within existing curbs shall be performed in accordance with these specifications as well as the requirements within the Colchester highway ordinances.

2.14 CEMENT CONCRETE SIDEWALK:

A. DESCRIPTION

This item shall consist of sidewalk made of one course Portland cement concrete not less than five inches (5") thick and with a width of not less than five feet (5'). Where the sidewalk crosses a driveway, the depth of concrete shall not be less than six inches (6") for residential driveways and eight inches (8") for commercial and industrial driveways for the full width of the driveway. The sidewalk shall be constructed in accordance with these specifications and the cross-sections shown on the accepted drawings.

B. MATERIALS

All concrete used in the construction of cement concrete sidewalks shall be Air Entrained not less than five percent nor more than seven percent so determined by an air meter approved by the Engineer. This concrete shall have a 28-day compressive strength of 3,500 psi and shall meet Section 501 of the State of Vermont Standard Specifications for Construction for Class B concrete or as periodically amended.

C. CONSTRUCTION METHODS

Preparation of subgrade: All boulders, organic material, soft clay, spongy material, and any other objectionable material shall be removed and replaced with approved material. The sub-grade shall be properly shaped, rolled, and uniformly compacted to conform with the accepted cross-sections and grades.

Base: A minimum base depth of six inches (6") of compacted crusher run gravel (704.05) or sand (704.03) shall be constructed on the subgrade to accepted cross-sections and grades.

Forms for concrete: The forms for the concrete shall be of wood or metal, well-oiled, straight, free from warps or kinks, and of sufficient strength. They shall be staked securely enough to resist the pressure of the concrete without spring. When ready for the concrete to be deposited, they shall not vary from the approved line and grade and shall be kept so until the concrete has set.

Placing and finishing concrete: Just prior to placing the concrete, the subgrade shall be moistened. After being mixed to the proper consistency, the concrete shall be placed in the forms and thoroughly tamped in place so that all honeycombs will be eliminated and sufficient mortar will be brought to the surface. After this, the surface shall be brought to a smooth, even finish by means of

a float. The surface shall be broom finished. All faces adjacent to the forms shall be spaded so that after the forms are stripped the surface of the faces will be smooth, even, and free of honeycombs. All edges shall be tool-rounded with an edge having a quarter inch (1/4") radius.

Expansion joints and scoring concrete: Half inch (1/2") transverse expansion joints shall be placed at intervals not exceeding twenty feet (20'). Sidewalks shall be scored to a depth of one inch (1") every five feet (5').

Curing concrete: Same as for Cement Concrete Curb.

Backfilling: Backfill shall be of suitable bank run gravel and shall be placed and tamped until firm and solid. Backfilling shall follow immediately after the concrete forms have been removed.

Anti-Spalling Compound: When the initial curing period is over (approximately 28 days after placement), all exposed surfaces shall receive two coats of anti-spalling compound. The surfaces shall be cleaned and then the compound shall be applied; the first coat at a rate of 0.025 gallons per square yard, the second at a rate of 0.015 gallons per square yard. Anti-spalling compound shall only be applied when the air temperature is above 50 degrees Fahrenheit.

Seasonal limits: No concrete shall be poured on a frozen or thawing subgrade during unseasonable weather conditions or when the temperature is 38 degrees Fahrenheit and falling. The Contractor shall record the temperature daily as outlined in the Proposed Recommended Practice - Cold Weather Concreting, ACI 306. In hot weather, the temperature of freshly placed concrete shall not be allowed to exceed 85 degrees Fahrenheit, conforming to ACI 305.

2.15 CEMENT CONCRETE DRIVEWAY APRONS:

A. DESCRIPTION

This item shall consist of a Portland cement concrete driveway apron not less than six inches (6") thick or as indicated on the plans to be constructed on a prepared subgrade in accordance with these specifications and as shown on the accepted drawings.

B. MATERIALS

All concrete used in the construction of cement concrete driveway aprons shall be Air Entrained not less than five percent nor more than seven percent so determined by an air meter approved by the Engineer. This concrete shall have a 28-day compressive strength of 3,500 psi and shall meet Section 501 of the State of Vermont Standard Specifications for Construction for Class B concrete or as periodically amended.

C. CONSTRUCTION METHODS

Preparation for subgrade: Same as for Cement Concrete Sidewalk.

Forms for concrete: Same as for Cement Concrete Curb.

Placing and finishing concrete: Same as for Cement Concrete Sidewalk.

Expansion joints: Half inch (1/2") transverse expansion joints shall be placed where the driveway apron and driveway joins the sidewalk and curb or pavement.

Curb: Curbs shall be constructed so as to protrude one and one-half inches (1 1/2") above the roadway surface at the entrance to the driveway. This curb shall be constructed with a smooth and gradual depression transition which shall not exceed nine inches (9") in length.

Curing concrete: Same as for Cement Concrete Curb.

Seasonal limits: Same as for Cement Concrete Curb.

2.16 BITUMINOUS CONCRETE DRIVEWAY APRONS:

A. DESCRIPTION

This type of pavement shall be composed of mineral aggregate, mineral filler if required, and bituminous material, plant mixed and laid hot. This pavement shall be constructed in two courses on the prepared or existing base in the same courses and thicknesses as the road cross-section in accordance with these specifications and in conformity with the lines, grades, thickness and type of pavement.

B. MATERIALS

The course aggregate shall consist of clean, hard crushed rock or screened crushed gravel free from dirt or foreign matter. It shall be reasonably free from soft and elongated pieces.

The fine mineral aggregate shall consist of sand or a mixture of sand and stone screenings of which at least 50 percent by weight shall be sand. The sand shall consist of clean, hard, durable grains free from injurious amounts of vegetable matter or other harmful substances.

The asphalt cement shall conform to all the requirements as set forth in Sections 702 and 704.10 of the Vermont Standard Specifications for Construction, or as periodically amended.

C. CONSTRUCTION METHODS

Equipment for spreading and finishing the mixture shall be a mechanical spreading and finishing machine provided with an activated screed and heated if required. The machine shall be capable of spreading the mixture without segregation and shall be approved by the Town Engineer before being used.

Application of bituminous concrete pavement shall meet all the requirements of the Vermont Standard Specifications for Construction, Section 406, or as periodically amended including, but not limited to, the following:

WEATHER LIMITATIONS: Bituminous material shall not be placed between November 1 and May 1. Material shall not be placed when the air temperature at the paving site in the shade and away from artificial heat is 40 degrees Fahrenheit or below.

CONDITIONING: Prior to placing the bituminous material, the existing surface shall be cleaned then sprayed with a coat of Emulsified Asphalt, RS-1.

COMPACTION: Immediately after the bituminous mixture has been spread, struck off, and surface irregularities adjusted, it shall be thoroughly and uniformly compacted by rolling. Along forms, curbs, headers, walls, and other places not accessible to the rollers, the mixture shall be thoroughly compacted with hot or lightly oiled hand tampers, smoothing irons, or mechanical tampers. On depressed areas, a trench roller may be used; or cleated compression strips may be used under the roller to transmit compression to the depressed area.

SURFACE TOLERANCES: The surface will be tested by the Engineer using a 16 foot straight-edge at selected locations parallel with the centerline. Any variations exceeding three-sixteenths of an inch (3/16") between any two contacts shall be satisfactorily eliminated. A ten foot straight-edge may be used on a vertical curve. The straight-edges shall be provided by the Contractor.

2.17 STREET GUARD RAIL OR BARRIER:

This item shall consist of the construction of twelve gauge standard steel beam-and-post guard rail, conforming to the design indicated on the accepted drawings, Sections 621 and 728 of the Vermont Standard Specifications for Construction as periodically amended, and pages G-1 and G-1d of the Vermont Design Standards.

This item may also consist of roadside barriers of other types which shall conform to the latest edition of the AASHTO Roadside Design Guide and shall be approved by the Town Engineer.

2.18 STREET SIDELINE MONUMENTS:

A. DESCRIPTION

This item shall consist of installing street property sideline monuments at all street intersections and at all points of curve and/or tangency or other critical points in the street lines as will enable a land surveyor to reconstruct the street geometry.

B. MATERIALS

Reinforced concrete monuments shall be those as manufactured by S.T. Griswold, or equivalent, and shall be 4"x 4"x 36". The top shall have a marked center which shall be the point of reference.

C. CONSTRUCTION METHODS

The monuments shall be set vertically and to the depth so that the top of the monument will project one-half inch (1/2") above the surrounding finished ground surface. The monuments shall be set in place after all other street improvements are completed. The monument's location shall be established by a surveyor licensed in the State of Vermont.

2.19 PLANTING OF TREES:

The Municipality may require the planting of new trees in areas where no trees presently exist, within the area disturbed by new construction, or in an area which substantial loss of trees has or will occur in the process of the road construction.

Such trees shall be preferably of a type indigenous to the neighborhood. Such trees shall be planted in fertile or fertilized ground and shall be watered and nurtured after planting until growth is assured.

Trees shall have a minimum diameter of trunk at a point four feet (4') above ground level of at least two inches (2"). They shall be planted at intervals of no more than sixty feet (60') on both sides of the street. Such trees shall be clear of any branches from a point of ground level to a point six feet (6') above ground level. All new trees shall be planted outside of the street right-of-way and utility, drainage, or other public easements.

2.20 STREET SIGNS, MARKINGS, SIGNALS AND GEOMETRIC IMPROVEMENTS:

A. DESCRIPTION

This item shall consist of street name signs, traffic signs, pavement markings and traffic signals constructed in accordance with these specifications and as shown on the accepted drawings. The Developer is responsible for the design and installation of the street improvements, signs, markings and signals that are warranted.

Driveways, streets and intersections shall be designed and constructed to meet the latest standards of the State of Vermont Agency of Transportation (VAOT), the American Association of State Highway and Transportation Officials (AASHTO), the Manual on Uniform Traffic Control Devices (MUTCD), and the Institute of Transportation Engineers (ITE).

Geometric improvements for new or existing streets and intersections shall be constructed by the Developer in accordance with the latest VAOT, AASHTO, MUTCD and ITE specifications if the improvements are warranted in accordance with the following methods;

1. Right and/or left turn lanes shall be constructed if warranted in accordance with the latest methodology used by the VAOT.

2. Traffic signals shall be installed if warranted in accordance with the methodology found in the latest edition of the MUTCD.
3. New project intersections or affected adjacent existing intersections shall be constructed or reconstructed by the Developer to maintain the following level of service (LOS):
 - a. Signalized intersections will be improved to maintain an over all minimum level of service D, and to maintain a minimum level of service E on any turning movement.
 - b. Unsignalized intersections will be improved to maintain a minimum level of service C for the major road, and a minimum level of service E for the minor road.

B. MATERIALS AND METHODS

The signs, posts, markings and signals shall conform to sections 646, 675, 677 and 678 of the Vermont Standard Specifications for construction, as required in these Specifications and as required by the Town Engineer.

2.21 STREET LIGHTING:

Streets and roadways shall be illuminated by standard down-shielded street lights, approved by the Municipality, a maximum of four hundred feet (400') apart and at all street intersections. The street lights will be installed on the sidewalk side of the street. Poles, brackets, and lights for street lighting are to be approved as to size, type, and location by the Municipality. They shall be complete and fully energized prior to acceptance of the street by the Municipality.

2.22 LANDSCAPING:

At completion of grading, slopes, ditches, and all disturbed areas shall be smooth and free of pockets with sufficient slope to ensure drainage.

All disturbed areas shall receive a minimum of four inches (4") of topsoil and shall be seeded, fertilized, limed, and mulched in accordance with the following:

1. Seed mixture in lawn areas around dwellings and within street limits shall be urban mix conforming to the adjacent Table. For seeding between September 1 and October 1, winter rye shall be used in addition to the urban mix at an application rate of 100 pounds per acre.

URBAN MIX GRASS SEED		
% BY WEIGHT	LBS. LIVE SEED PER ACRE	TYPE OF SEED
37.5	45	CREeping RED FESCUE
37.25	37.5	KENTUCKY BLUEGRASS
31.25	37.5	WINTER HARDY, PERENNIAL RYE
100	120 # LIVE SEED PER ACRE	

2. Seed mixture in all other disturbed areas shall be conservation mix conforming to the adjacent Table. For seeding between September 1 and October 1, winter rye shall be used in addition to the urban mix at an application rate of 100 pounds per acre.

CONSERVATION MIX GRASS SEED		
% BY WEIGHT	LBS. LIVE SEED PER ACRE	TYPE OF SEED
35	35	CREeping RED FESCUE
23	23	KENTUCKY BLUEGRASS
15	15	ANNUAL RYE
11	11	WINTER HARDY, PERENNIAL RYE (VARIETY PENNINE, MANHATTAN OR SIMILAR VARIETY)
6	6	WHITE CLOVER
10	10	HIGHLAND BENTGRASS
100	100# LIVE SEED / ACRE	

2.23 STUMP DISPOSAL:

On any project in which site development requires the removal of the tree stumps, the disposal of the stumps may be accomplished on the site. On-site stump disposal plans shall be submitted to and approved by the Town Engineer.

Such plan(s) shall show that the on-site disposal can be safely and effectively accomplished and will meet the following minimum guidelines:

- A. Disposal sites shall be located on nearly level to moderately sloping lands (slopes less than 12 percent).
- B. Disposal sites will not be located in or within 100 feet of flowing watercourses or streams or in actively eroding gullies.
- C. Disposal site shall not be located in flooded or flooding-prone lands, marshes, or other aquifer recharge areas.
- D. Stumps will be placed on the site in a single lift prior to backfilling. When additional stumps are to be deposited on the same site, each successive layer or lift of stumps will be backfilled.
- E. Stumps deposited in drainageways or depressions shall backfilled and bermed so as to divert overland flows the disposal area.
- F. A minimum of two feet (2') of overburden will be placed over all disposal sites.
- G. Disposal sites shall be located outside any planned development area of structures, utilities, parking areas, streets, etc.
- H. All disturbed surfaces shall be properly limed, fertilized, seeded, and mulched to provide for a stable, non-erosive, vegetated cover. Specific seeding recommendations and lime or nutrient requirements will be based upon soil tests and site conditions on that location.

Section 3

STORM DRAINAGE SYSTEM

3.0 GENERAL:

This item shall consist of catch basins, manholes, and pipe meeting the specifications for the diameter of pipe required and installed as indicated on the drawings. The Developer's Engineer shall submit the stormwater collection and detention system calculations to the Town Engineer for review and approval. Stormwater designs shall be based upon a 25 year storm event.

3.1 MATERIALS:

A. *TYPES OF PIPE*

Types of pipe which may be used for storm drain lines are Reinforced Concrete Pipe (RC), Corrugated Polyethylene Pipe (PE), Polyvinyl Chloride Pipe (PVC); or an approved equal. Types of pipe which may be used for culverts are Reinforced Concrete Pipe (RCP), Corrugated Galvanized Metal Pipe (CGMP), Corrugated Polyethylene Pipe (PE), or an approved equal.

B. *REINFORCED CONCRETE PIPE*

Pipe shall conform to the Vermont Standard Specifications for Construction, Section 710, and AASHTO, M170.

C. *CORRUGATED GALVANIZED METAL PIPE*

Pipe shall conform to standard specification for CGM pipe, AASHTO, M190. Pipe shall have a polymeric coating conforming to AASHTO M 246 Type B. Where indicated, Contractor shall install 24" wide bands with a watertight gasket in lieu of standard pipe collars.

D. *POLYVINYL CHLORIDE PIPE*

Pipe shall conform to ASTM Specification D-3034 or F679, (PVC) Sewer Pipe and Fittings, SDR35, or Perma-Loc sewer pipe and fittings in compliance with ASTM F794.

E. *CORRUGATED POLYETHYLENE PIPE*

Pipe shall conform to AASHTO M294-90, Type S.

F. *MANHOLES*

Where indicated on the plans, the Contractor shall furnish and install manholes which meet the requirements of the sanitary sewer manholes of these specifications. Frame and covers shall be LeBarron LC 266 Type C and shall say DRAIN on the cover.

G. *CATCH BASINS*

Catch basins shall be constructed of reinforced concrete and shall be provided with cast iron

frames and grates. Frames and grates shall be Neenah R-3405-A, R-3210-L (for grades exceeding 5%), or an approved equal.

Precast risers and base sections shall conform to the Vermont Standard Specifications for Construction, Section 604, or as periodically amended. Frames shall be brought to grade with at least two, but not more than six, courses of brick and shall be set in a full bed of mortar. All brick surfaces shall be plastered with cement mortar, the plaster being carried up as the brickwork progresses.

Precast risers and bases for manholes shall conform to ASTM Specifications C-361. The pipe opening in the precast manhole riser shall have a cast-in-place flexible gasket or an equivalent system for pipe installation as approved by the Engineer. Joints between manhole risers shall be rubber "O" ring seals or soft Butyl joint sealer (rope form).

The frames shall be set to final grade only after the curbs have been completed.

3.2 CONSTRUCTION METHODS:

A. *LAYING PIPE*

Storm drains and culverts shall be constructed in accordance with the Vermont Standard Specifications for Construction, Section 601, or as periodically amended; and on a trench bottom, they shall be prepared and bedded as shown on the drawings. Each pipe shall be checked just prior to laying to ensure that it is clear of all dirt and debris. It shall be laid true to line and grade as indicated on the contract drawings. All joints shall be tight, and inverts shall be continuous.

Metal pipe and CPP shall be firmly joined with coupling bands, concrete pipe joints shall be a rubber-gasket type, and PVC pipe shall be joined with standard push-on type using elastomeric gaskets.

Storm drains and culverts with water flow velocities greater than 12 feet per second shall require special design which must be approved by the Engineer. Storm drains and culverts shall have minimum velocities of 2 feet per second.

B. *BACKFILLING*

All material for backfilling shall be free of roots, stumps, and frost. Backfill for all pipelines shall be placed in six inch (6") layers, each layer being thoroughly compacted to not less than 95 percent of maximum dry density as determined by the ASTM D698 Standard Proctor by a means approved by the Town Engineer.

C. *PIPE BEDDING*

Reinforced concrete pipe and asphalt-coated corrugated galvanized metal pipe shall be bedded from the trench bottom to the centerline of the pipe to a height of one foot (1') above the top of the pipe with material excavated from the trench having no stones larger than one and a half inches (1½")

in the longest dimension. Should no excavated material be suitable, sand or gravel shall be used.

PVC and CPP pipe shall be bedded with crushed stone and then backfilled with material excavated from the trench having no stones larger than one and a half inches (1½") in the longest dimension. Sand or gravel shall be used if no excavated material is suitable.

D. HEADWALLS

The Contractor shall construct pipe headwalls at the outfall end of all storm lines or as ordered by the Town Engineer. Headwalls shall be either specifically designed polymeric-coated corrugated galvanized metal end sections, concrete, or rubble masonry construction.

If constructed of concrete or masonry rubble, headwalls shall conform to the Vermont Standard Specifications for Construction, Section 602. All concrete utilized for the purpose shall meet the requirements for Class B concrete as per the Vermont Standard Specifications for Construction, Section 501. End sections shall conform to the Vermont Standard Specifications for Construction, Section 711, or as periodically amended.

E. DETENTION BASINS

If necessary stormwater detention swales, drains, or basins will be constructed downgradient of all new developments to limit post development stormwater runoff flows to equal to or less than pre-development stormwater runoff flows for a minimum twenty-five year, twenty-four hour storm event.